

Amendments to the Claims

Please cancel Claims 25, 28 and 66-80. Please amend Claims 26, 27, 29, 32, 36-41, 44, and 58-59. The Claim Listing below will replace all prior versions of the claims in the application:

Claim Listing

1. (Previously presented) A method for increasing the efficiency of a system comprising a fuel reformer coupled to a fuel cell, the method comprising the steps of:
 - providing pressurized air;
 - using heat generated by the fuel cell to make a pressurized air/steam mixture, optionally in admixture with water, by direct evaporation of cooling water from the fuel cell into the pressurized air;
 - introducing the air/steam mixture as an oxidant into a fuel burner;
 - producing a steam-containing exhaust having an expansion potential from the fuel burner;
 - driving an expander using the expansion potential of the steam-containing exhaust; and
 - recovering mechanical energy from the expander in excess of the energy used in compressing the pressurized air.
2. (Previously presented) The method of Claim 1, further comprising the step of preheating the air/steam mixture in the steam-containing exhaust of the fuel burner before introduction into the burner.
3. (Original) The method of Claim 1, further comprising the step of using the air/steam mixture as a humidified oxidant of a fuel cell.
4. (Previously presented) The method of Claim 1, further comprising the step of introducing additional water into the air/steam mixture.

5. (Previously presented) The method of Claim 4, wherein the step of introducing additional water occurs after the mixture has emerged from the fuel cell.
6. (Original) The method of Claim 1, wherein the steam-containing exhaust is a heat source for a fuel reformer.
7. (Original) The method of Claim 6, wherein the fuel reformer conducts at least one reaction selected from the group consisting of steam reforming, partial oxidation and autothermal reforming.
8. (Original) The method of Claim 7, wherein the fuel reformer reaction comprises steam reforming.
9. (Original) The method of Claim 1, further comprising the step of treating a reformat to reduce carbon monoxide concentration.
10. (Original) The method of Claim 9, wherein the step of treating a reformat is at least one of the following processes selected from the group consisting of a water gas shift, preferential oxidation of carbon monoxide, preferential methanation of carbon monoxide with hydrogen on a catalyst, separation of hydrogen in a pressure swing absorption bed, separation of hydrogen in a temperature swing absorption bed, and separation of hydrogen by a hydrogen-selective membrane.
11. (Original) The method of Claim 9 wherein the step of treating a reformat comprises a water gas shift.
12. (Original) The method of Claim 9, wherein the step of treating a reformat consists essentially of at least one water gas shift and at least one preferential oxidation of carbon monoxide.

13. (Original) The method of Claim 1, further comprising the step of heating a reformer with the burner exhaust before driving the expander.
14. (Original) The method of Claim 1, further comprising the step of heating a reformer with the burner exhaust after driving the expander.
15. (Original) The method of Claim 4, wherein the air/steam mixture travels a path from the fuel cell to the burner and wherein water is present in the air/steam mixture in at least part of the path.
16. (Previously presented) The method of Claim 15, further comprising the step of removing water from the air/steam mixture at a selected point in the path before introduction of the mixture into the burner.
17. (Original) The method of Claim 1, wherein the expander is a turbine.
18. (Previously presented) An integrated fuel generator/fuel cell system, the system comprising:
 - a fuel reformer;
 - a fuel cell coupled to the fuel reformer;
 - a cooling system for the fuel cell configured to produce heated water;
 - a source of pressurized air, pressurized air from the source being used to evaporate the heated water thereby creating a pressurized air/steam mixture;
 - a burner in which the air/steam mixture is combusted with a fuel to create a steam-containing burner exhaust; and
 - an expander in which the burner exhaust expands to produce a mechanical power output in excess of the power absorbed in compressing the pressurized air.
19. (Original) The system of Claim 18, wherein the expander is a turbine.

20. (Original) The system of Claim 18, further comprising a burner exhaust conduit configured to permit heating of the fuel reformer by the burner exhaust and then to direct the exhaust through the expander.
21. (Original) The system of Claim 18, further comprising a burner exhaust conduit configured to permit heating of the fuel reformer after the exhaust passes through the expander.
22. (Original) The system of Claim 18, wherein the air/steam mixture further comprises water in at least a part of a path between the fuel cell and a point of injection into the burner.
23. (Original) The system of Claim 18, further comprising a carbon monoxide removal system.
24. (Original) The system of Claim 23, wherein the carbon monoxide removal system produces an output which comprises less than about 10 ppm of carbon monoxide on a time-averaged basis.
25. (Cancelled)
26. (Currently amended) The method of Claim ~~25~~ 58, wherein the step of heating is provided by at least one of the sources selected from the group consisting of a combustion zone, exhaust of a combustion zone, a fuel reformer; and a carbon monoxide removal system.
27. (Currently amended) The method of Claim ~~25~~ 58, wherein the expander is a turbine.
28. (Cancelled)

29. (Currently amended) The method of Claim ~~28~~ 59, wherein the steam-containing exhaust is a heat source for a fuel reformer.
30. (Original) The method of Claim 29, wherein the fuel reformer conducts at least one reaction selected from the group consisting of steam reforming, partial oxidation and autothermal reforming.
31. (Original) The method of Claim 30, wherein the fuel reformer reaction comprises steam reforming.
32. (Currently amended) The method of Claim ~~28~~ 59, further comprising the step of treating a reformat to reduce carbon monoxide concentration.
33. (Original) The method of Claim 32, wherein the step of treating a reformat is at least one of the reactions selected from the group consisting of a water gas shift, preferential oxidation of carbon monoxide, preferential methanation of carbon monoxide with hydrogen on a catalyst, separation of hydrogen in a pressure swing absorption bed, separation of hydrogen in a temperature swing absorption bed, and separation of hydrogen by a hydrogen-selective membrane.
34. (Original) The method of Claim 32, wherein the step of treating a reformat comprises a water gas shift.
35. (Original) The method of Claim 32, wherein the step of treating a reformat consists essentially of at least one water gas shift and at least one preferential oxidation of carbon monoxide.
36. (Currently amended) The method of Claim ~~28~~ 59, further comprising the step of heating a reformer with the burner exhaust before driving the expander.

37. (Currently amended) The method of Claim 28 59, further comprising the step of heating a reformer with the burner exhaust after driving the expander.
38. (Currently amended) The method of Claim 28 59, further comprising the step of preheating the air/steam mixture by heat exchange with the steam-containing exhaust before reacting the air/steam mixture.
39. (Currently amended) The method of Claim 28 59, further comprising the step of using at least some of the air/steam mixture as a humidified oxidant of a fuel cell before evaporating water into pressurized air.
40. (Currently amended) The method of Claim 28 59, further comprising the step of introducing additional water into the air/steam mixture.
41. (Currently amended) The method of Claim 40, wherein the step of introducing additional water occurs after the mixture has emerged ~~from~~ from the fuel cell.
42. (Original) The method of Claim 40, wherein the air/steam mixture travels a path from the fuel cell to the burner and wherein water is present in the air/steam mixture in at least part of the path.
43. (Previously presented) The method of Claim 42, further comprising the step of removing water from the air/steam mixture at a selected point in the path before introduction of the mixture into the burner.
44. (Currently amended) The method of Claim 28 59, wherein the expander is a turbine.
45. (Previously presented) An integrated fuel generator/fuel cell system, the system comprising:
 - a fuel cell having a cathode and an anode;

a source of pressurized air coupled to the cathode of the fuel cell;
a fuel reformer coupled to the fuel cell;
a mixer in which pressurized air from the source is used to evaporate heated water thereby creating a pressurized air/steam mixture used as a fuel cell oxidant;
a burner in which the air/steam mixture is combusted with a fuel to create a steam-containing burner exhaust gas; and
an expander in which the burner exhaust gas expands, thereby creating mechanical energy in excess of the energy used to compress the pressurized air.

46. (Original) The system of Claim 45, further comprising at least one heat exchanger to heat the air/steam mixture;
47. (Original) The system of Claim 46, wherein at least one heat exchanger is located within the fuel reformer.
48. (Original) The system of Claim 47, further comprising a radiator for cooling the fuel cell coolant wherein the radiator is configured to a size smaller than a size required to otherwise cool the coolant if a portion was not being used to humidify the cathode of the fuel cell.
49. (Original) The system of Claim 45, wherein the mixer comprises a humidifier.
50. (Original) The system of Claim 45, wherein the heated water is supplied by a fuel cell coolant.
51. (Original) The system of Claim 45, wherein the expander is a turbine.
52. (Original) The system of Claim 45, further comprising a burner exhaust conduit configured to permit heating of the fuel reformer by the burner exhaust and then to direct the exhaust through the expander.

53. (Original) The system of Claim 45, further comprising a burner exhaust conduit configured to permit heating of the fuel reformer after the exhaust passes through the expander.
54. (Previously presented) The system of Claim 45, wherein the air/steam mixture further comprises water in at least a part of a path between the fuel cell and a point of introduction into the burner.
55. (Original) The system of Claim 45, further comprising a carbon monoxide removal system.
56. (Original) The system of Claim 55, wherein the carbon monoxide removal system produces an output which comprises less than about 10 ppm of carbon monoxide on a time-averaged basis.
57. (Original) The method of claim 1, further comprising the use of the heat exchanger that cools the exhaust after it leaves the expander as a preheater for at least one of the feeds for the burner, thereby recuperating the turbine exhaust.
58. (Currently amended) ~~The method of claim 25, further comprising~~ A method of increasing the efficiency of a fuel cell, the method comprising the steps of:
converting at least some waste heat of the fuel cell to a pressurized gas/steam mixture by evaporating heated cooling water into a pressurized oxygen-containing gas and passing the gas through the fuel cell as oxidant;
heating the gas/steam mixture;
passing the heated mixture through an expander;
recovering mechanical power from the expander in excess of the power absorbed in compressing the pressurized oxygen-containing gas; and

~~the use of the~~ using a heat exchanger that cools the exhaust after it leaves the expander as a preheater for at least one of the feeds for the burner, thereby recuperating the ~~turbine~~ expander exhaust.

59. (Currently amended) ~~The method of claim 28, further comprising~~ A method for generating power from fuel cell waste heat comprising the steps of:

evaporating water into pressurized air using waste heat from a fuel cell to create a pressurized air/steam mixture;

reacting the air/steam mixture in a burner to produce a steam-containing exhaust;

driving an expander with the steam-containing exhaust to produce mechanical energy in excess of the energy used to compress the pressurized air; and

~~the use of the~~ using a heat exchanger that cools the exhaust after it leaves the expander as a preheater for at least one of the feeds for the burner, thereby recuperating the ~~turbine~~ expander exhaust.

60. (Original) The system of claim 18, further comprising the provision of a heat exchanger that cools exhaust from the expander and heats at least one of the feeds for the burner, thereby recuperating the turbine exhaust.
61. (Previously presented) The method of Claim 1, further comprising preheating at least one of a steam fuel mixture, anode gas, and steam.
62. (Previously presented) The method of Claim 61, wherein the preheating is performed through concentrically arranged annuli.
63. (Previously presented) The fuel reformer of Claim 18, further comprising a shell-type exchanger having annuli with gaps formed between the shells between which heat is exchanged.

64. (Previously presented) The fuel reformer of Claim 63, wherein the annuli are arranged around a centrally located heat exchanger through which expanded burner exhaust is routed.
65. (Previously presented) The fuel reformer of Claim 63, further comprising at least one of a high temperature shift bed, a low temperature shift bed, a burner, a partial oxidation reactor, and an autothermal reformer around which the small gap annuli are arranged.

Claims 66. - 80. (Cancelled)